How many quarks and leptons ?

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Abstract

There are eight quarks in each family and there are three families of quarks i.e. c, b, t. Also, we propose similar structure for leptons. The nature of strong force is named as 'third order electroweak'.

1 Introduction

After more than 30 years of continuous advances we might expect that Quantum Chromodynamics (QCD), the established theory of strong interactions, would provide us with a satisfactory understanding of high energy hadronic reactions [1]. Unfortunately this is not yet the case [2]. Data taken by ZEUS collaboration at HERA [3] show that the leading particle spectra measured in photoproduction and in deep inelastic scattering (DIS) (where $Q^2 \geq 4$ GeV^2) are very similar. This suggests that, as pointed out in [4], QCD hardness scale for particle production in DIS gradually decreases from a (large) Q^2, which is relevant in the photon fragmentation region, to a soft scale in the proton fragmentation region. We can therefore expect a similarity of the inclusive spectra of the leading protons in high energy hadron-proton collisions and in virtual photon-proton collisions. In other words, we may say that the photon is neither resolving nor being resolved by the fast emerging protons. This implies that these reactions are dominated by some non-perturbative mechanism. This is confirmed by the failure of perturbative QCD [5].

The exploration of physics with b-flavoured hadrons offers a very fertile testing ground for the standard model (SM) description of electroweak interactions [6]. B-meson physics is a vast subject, full of challenges and its decays to light mesons offer the possibility to access the less well-known entries in the Cabibbo-Kobayashi-Maskawa (CKM) quark mixing matrix [7, 8] elements, like V_{ub} and V_{ts} [9]. Therefore, the understanding of flavour dynamics, and of the related origin of quark and lepton masses and mixings, is among the most important goals of elementary particle physics. Another important goal is then to find out whether the Standard Model (SM) is able to describe the flavour and CP violation observed in nature. All the existing data on weak decays of hadrons, including rare and CP-violating decays, can at present be described by the SM within the theoretical and experimental uncertainities. On the other hand, the SM is an incomplete theory: some kind of new physics is required in order to understand the patterns of quark and lepton masses and mixings, and generally to understand flavour dynamics [10]. There are strong theoretical arguments suggesting that new physics cannot be far from the electroweak scale.

Radiative B decays to kaons provide a rich laboratory to test the SM and probe new physics. $B \to K^*\gamma$ is a well established process among them. Higher resonant kaons such as $K_2^*(1430)$ are also measured by CLEO [11] and the B factories [12, 13]. Recently, Belle has announced the first measurement of $K_1(1270)$ and upper bound on $K_1(1400)$ [14]. The higher kaon resonances share lots of things with $B \to K^*\gamma$. At the quark level, both of them are governed by $b \to s\gamma$. All of the accumulated achievements of $b \to s\gamma$ can be used in radiative B decays to kaon resonances. But we have big difference between theory and experiment of radiative B decays to K^* and K_1 resonances. The details of differences are quite opposit [15, 16]. In short, the form factors

$$\begin{aligned} F^{K^*}_{theory} &> F^{K^*}_{exp}, \\ F^{K_1}_{theory} &\ll F^{K_1}_{exp}. \end{aligned}$$

Kown and Lee explained some of the possible candidates of the discrepancy [16].

The scheme of the article is: Section 2 is devoted to the existance of QCD. Quark and lepton families structure is presented in Sec. 3 and 4, respectively. Conclusion is given in Sec. 5.

2 Is massless QCD really wrong ?

Yes, massless QCD is exactly wrong (here "massless" means the massless colored gluons). Why ? QCD is a theory based on the color charges, i.e., red, green, and blue. But the value of color charges do not predicted and these color charges given to the fundamental particles, like quarks and gluons, on hypothetical basis. It was pointed out for the first time that the color charges given to gluons violate the group property [17] and only color or anticolor charge can be given to the gluons. The value of color charges is predicted for the first time in a recent article by Gilani [18]. The quark fractional charges are also rejected because there was no use of quark fractional charges after giving the numerical value to the color charges [18]. It was proposed first time that the up-type quarks will carry color charges and down-type quarks will carry anticolor charges [18]. First time, the gluons structure was proposed by set theory [17]. With the help of set theory, it was suggested that only one gluon is massless while the remaining seven gluons are massive. Out of seven massive gluons, three carry color charges and three carry anticolor charges and one is color singlet. The color singlet gluon is massive than colored or anticolored gluons. Overall, two gluons are neutral, one is massless and the other is massive. The remaining six gluons are charged. The mathematical proof of all the above observations [17] about gluons is given in Ref. [18] and obtained exactly the same results as predicted by set theory [17]. The mass of the Higgs boson is also predicted first time in terms of the mass of W-boson [18].

3 How many quarks ?

Question was raised by Gilani [18] that if there are three quarks, then life becomes easy but he did not answer this question satisfactorily. We pointed out that quarks will not carry fractional charges but they will carry either color or anticolor charges like the gluons. In our recent article [18], we proposed the value of color charges by using the cube roots of unity. By using these value, we give color charges to up-type quarks i.e. u, c, t while anticolor charge to down-type quarks i.e. d, s, b. Here we cannot convince ourselves that at the same time one type of quarks will carry color charge and the other type of quarks will carry anticolor charge. What we conclude is, we can only give color charges to quarks and anticolor charges to antiquarks.

Table 1: Three quark families, i.e. Charm (c), Beauty (b), and Top (t).

Quarks	Charm (c)	Beauty (b)	Top (t)
Massless	$c^0 = d$	$b^0 = u$	$t^0 = s$
Red colored	$c^r = c^{+1}$	$b^r = b^{+1}$	$t^r = t^{+1}$
Green colored	$c^g = \left(-\frac{1}{2} + i\frac{\sqrt{3}}{2}\right) c^{-1}$	$b^g = \left(-\frac{1}{2} + i\frac{\sqrt{3}}{2}\right) b^{-1}$	$t^g = \left(-\frac{1}{2} + i\frac{\sqrt{3}}{2}\right) t^{-1}$
Blue colored	$c^b = \left(-\frac{1}{2} - i\frac{\sqrt{3}}{2}\right) c^{-1}$	$b^b = \left(-\frac{1}{2} - i\frac{\sqrt{3}}{2}\right) b^{-1}$	$t^b = \left(-\frac{1}{2} - i\frac{\sqrt{3}}{2}\right) t^{-1}$
Massive colorsinglet	c^z	b^z	t^z
Antiquarks			
Antiblue colored	$\bar{c}^{\bar{b}} = \left(+\frac{1}{2} + i\frac{\sqrt{3}}{2}\right) \bar{c}^{+1}$	$\bar{b}^{\bar{b}} = \left(+\frac{1}{2} + i\frac{\sqrt{3}}{2}\right) \bar{b}^{+1}$	$\bar{t}^{\bar{b}} = \left(+\frac{1}{2} + i\frac{\sqrt{3}}{2}\right) \bar{t}^{+1}$
Antigreen colored	$\bar{c}^{\bar{g}} = \left(+\frac{1}{2} - i\frac{\sqrt{3}}{2}\right) \bar{c}^{+1}$	$\bar{b}^{\bar{g}} = \left(+\frac{1}{2} - i\frac{\sqrt{3}}{2}\right) \bar{b}^{+1}$	$\bar{t}^{\bar{g}} = \left(+\frac{1}{2} - i\frac{\sqrt{3}}{2}\right) \bar{t}^{+1}$
Antired colored	$\bar{c}^{\bar{r}} = \bar{c}^{-1}$	$\bar{b}^{\bar{r}} = \bar{b}^{-1}$	$\bar{t}^{\bar{r}} = \bar{t}^{-1}$

If we give color charge to some of the quarks and anticolor charge to other few quarks then it will simply be the assumption but there will be a big joke with the subject and we will go away from the reality. Here we again take the possibility that there are only three quarks but not six.

We, now, give here a new classifiction to quarks and reject the old classification by which the quarks were known. We reject the possibility of six quark families but propose three quark families. We name the three families as: charm (c), beauty (b), and top (t). We give them only color charges. Quarks have also the same structure as that of gluons which is explained in Refs. [17, 18]. Three quark families i.e. Charm, Beauty, top and their quark structure is given in Table 1.

There must be six quark-Higgs in each family of quarks. We can write the various mass relations among the quarks on the similar grounds as done for gluons in Ref. [18].

A stricking question: Is there any relation between the family members of quarks and/or leptons ?

4 How many leptons ?

Three leptons are exist in the literature i.e. electron (e^-), muon (μ^-), tau (τ^-) and their corresponding neutrinos i.e. electron neutrino (ν_e), muon

Table 2: Three lepton families i.e. electron, muon, tau

Anti-Leptons	Electron (e)	Muon (μ)	Tau (τ)
Massless neutrino (ν)	$e^0 = \nu_e$	$\mu^0 = \nu_\mu$	$\tau^0 = \nu_\tau$
red color	$e^r = e^{+1}$	$\mu^r = \mu^{+1}$	$\tau^r = \tau^{+1}$
green color	$e^g = \left(-\frac{1}{2} + i\frac{\sqrt{3}}{2}\right) e^{-1}$	$\mu^g = \left(-\frac{1}{2} + i\frac{\sqrt{3}}{2}\right) \mu^{-1}$	$\tau^g = \left(-\frac{1}{2} + i\frac{\sqrt{3}}{2}\right) \tau^{-1}$
blue color	$e^b = \left(-\frac{1}{2} - i\frac{\sqrt{3}}{2}\right) e^{-1}$	$\mu^b = \left(-\frac{1}{2} - i\frac{\sqrt{3}}{2}\right) \mu^{-1}$	$\tau^b = \left(-\frac{1}{2} - i\frac{\sqrt{3}}{2}\right) \tau^{-1}$
Massive colorsinglet (Massive neutrino)	$e^z = \nu_e^z$	$\mu^z = \nu_\mu^z$	$\tau^z = \nu_\tau^z$
Leptons			
antiblue	$e^{\bar{b}} = \left(+\frac{1}{2} + i\frac{\sqrt{3}}{2}\right) e^{+1}$	$\mu^{\bar{b}} = \left(+\frac{1}{2} + i\frac{\sqrt{3}}{2}\right) \mu^{+1}$	$\tau^{\bar{b}} = \left(+\frac{1}{2} + i\frac{\sqrt{3}}{2}\right) \tau^{+1}$
antigreen	$e^{\bar{g}} = \left(+\frac{1}{2} - i\frac{\sqrt{3}}{2}\right) e^{+1}$	$\mu^{\bar{g}} = \left(+\frac{1}{2} - i\frac{\sqrt{3}}{2}\right) \mu^{+1}$	$\tau^{\bar{g}} = \left(+\frac{1}{2} - i\frac{\sqrt{3}}{2}\right) \tau^{+1}$
antired	$e^{\bar{r}} = e^{-1}$	$\mu^{\bar{r}} = \mu^{-1}$	$\tau^{\bar{r}} = \tau^{-1}$

neutrino (ν_μ), and tau neutrino (ν_τ). These neutrinos are massless.

Let us assume that leptons have also similar structure as that of gluons [18] and quarks. If this is so, then we will see that there will be three families of leptons i.e. electron, muon and tau. The lepton structure is given in Table 2.

There must be six lepton-Higgs in each family of leptons. We can write the various mass relations among the quarks on the similar grounds as done for gluons in Ref. [18].

5 Conclusions

We proposed a structure for quarks and leptons similar to the one for gluons [17, 18]. We reject the possibility of six quark flavours and propose that there are only three quark and three lepton families. The new structure of quark and lepton families are given in Tables 1 and 2.

We summarize here the nature of all the four forces:

Name of force	**Nature of force**	**Gauge bosons**
Casimir force	Zeroth order electroweak	γ
Gravitational force	First order electroweak	γ, Z^0
Electroweak force	Second order electroweak	γ, W^+, W^-, Z^0
Strong force	Third order electroweak	Eight gluons [17, 18]

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